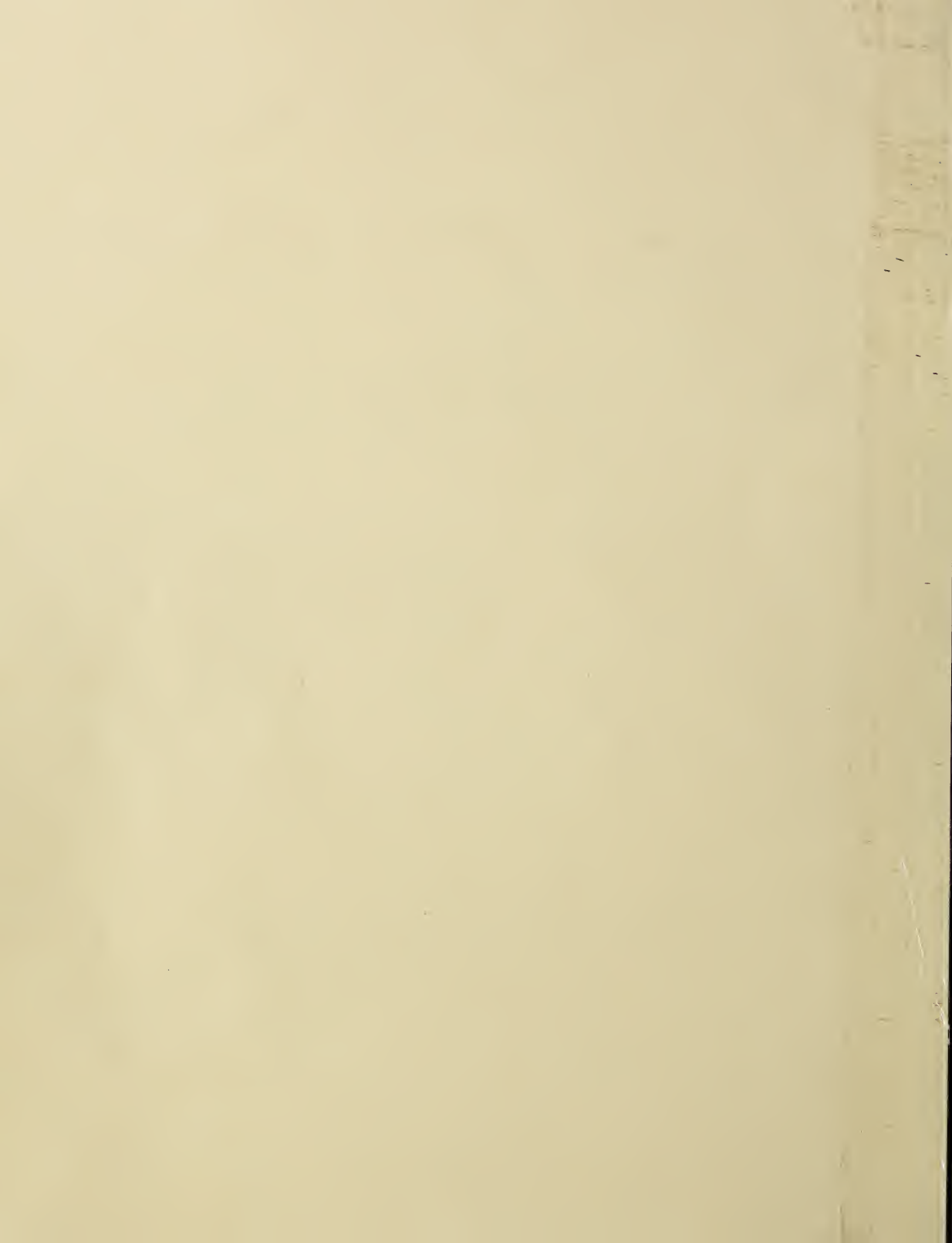


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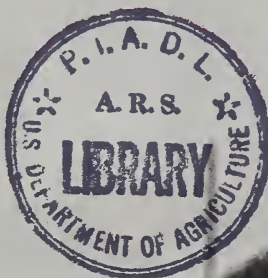


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AGRICULTURAL Research

October 1962 U.S. Department of Agriculture



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HOW CELLS MAKE PROTEIN** *Page 8*

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AGRICULTURAL Research

October 1962/Volume 11, No. 4

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Wise Use of Chemicals

It has often been said that we have the most wholesome, cleanest food supply in the world. Few question this fact. However, concern has been raised over methods of controlling pests that would rob us of an abundance of high-quality food.

In this issue of AGRICULTURAL RESEARCH, the lead article (10th in a centennial series) tells the story of more than 100 years of research in entomology. Much of this work has dealt with the proper use of chemicals to control pests.

These chemicals are a necessity in modern agriculture. When used according to label directions, they do not constitute a hazard to consumers.

To begin with, the Department regulates the interstate sale of these chemicals through enforcement of the Federal Insecticide, Fungicide, and Rodenticide Act. This law requires that manufacturers and formulators register the chemical product before it can be shipped in interstate commerce. The registrant must furnish USDA with sufficient research evidence to determine (1) that the product is useful and (2) that the product is safe from the standpoint of both the general public and the individual who uses it.

Through the enforcement of this act, USDA insures that the label will spell out proper use of the chemical. The farmer then is assured that he can grow crops that will not carry residues exceeding Food and Drug Administration tolerances.

Many readers of this magazine are agricultural leaders in research, extension, education. As such you can help keep our food supply wholesome and abundant by taking every opportunity to urge farmers and gardeners to use pesticides wisely—to read labels carefully and follow all directions.


Two-thirds of ARS research on insects today is devoted to the study of biological controls, development of chemicals with toxicity for specific insects, testing of attractants, and basic studies on insect physiology and pathology. Even so, we still must depend upon chemicals for the foreseeable future.

We must use chemicals, but we must use them wisely.

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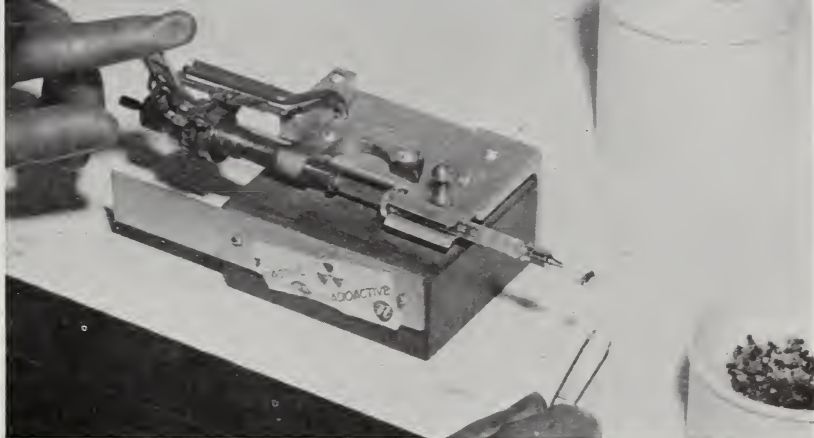


AGRICULTURAL RESEARCH SERVICE
United States Department of Agriculture



Tenth in a Centennial Series

*Radioactivity
is playing a
major role in
insect control
and research.*



ENTOMOLOGISTS

AGAINST INSECT PESTS

*Bright, new horizons are opening up to enlarge
our arsenal of weapons against harmful insects*

■ Scourge . . . plague . . . famine. These terrifying words are still associated with onslaughts of insect pests in many parts of the world. But not here in the United States.

For the past century USDA entomologists and other scientists with Federal, State, and industrial institutions have systematically developed ways to combat our insect enemies.

Mosquito-borne yellow fever and malaria once sacked our cities and struck down the labor force of entire regions of the country. Today, they are no longer a menace.

Grasshopper hordes will never again lay waste our crops.

We have crushed the invasion attempts of such alien pests as the Mediterranean fruit fly, which threatened an entire agricultural industry.

And, perhaps most important, entomology research has helped make it possible for American agriculture to take its place as one of the most abundant and efficient in the world.

Yet, insects still cost the American economy billions of dollars each year, a waste that will yield only to continuing research. The chemical insecticides that have been responsible for much progress in insect control have also created problems that are receiving close attention in current research. Some insecticides kill beneficial as well as harmful insects. Improperly used, they may leave harmful residues in foods, or create hazards for fish and wildlife. It has long been recognized that chemicals which kill insects are also potentially dangerous to man.

Gains reflect broad-scale research

The spectacular gains against insect pests during the past century reflect the broad research approach undertaken by scientists to develop and utilize every known means of pest control. Today's extensive use of chemicals is due to hard-won success in insecticide research. Other

methods of control have gained substantial but less frequent success as a result of wide-scale research efforts.

- Over the past hundred years, USDA entomologists have studied insects to find weaknesses in their makeup and their habits. These weaknesses are used against them.

- Useful cultural controls—crop rotations and deep plowing, for example—have been put to work.

- Painstaking breeding research has resulted in crops with built-in resistance to insect pests.

- A world search that still continues for beneficial insects has brought to this country many predatory and parasitic insects that help fight these pests.

One example is the ladybird beetle, brought by USDA entomologists from Australia in 1888 to combat the cottony cushion scale of citrus. This beneficial insect saved California's early citrus industry.

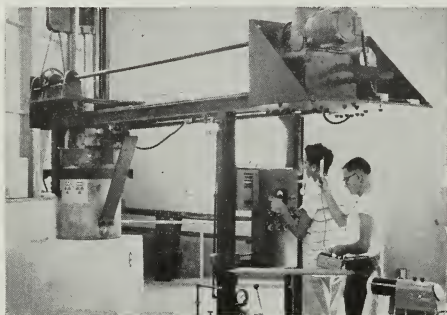
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Insecticides mean the difference between profit and loss. Untreated cotton, left, yielded one-tenth bale per acre; treated, a bale per acre.



Wasp, introduced to United States, fights alfalfa weevil.



Irradiation-sterility technique has freed Southeastern United States of screwworm.



Systemic insecticide is fed to guinea pigs to test its effect on screwworms, biting flies, and ticks.

ENTOMOLOGISTS (Continued)

This was a striking instance—and a striking exception, time has proved—of the effectiveness of biological control of insect pests.

More often, biological control efforts have only helped to partially control insect pests.

Biological control only partly effective

Most of the serious pests of American agriculture have come to this country from other parts of the world without their natural enemies. Efforts have been made to import many of these natural enemies, but the desired balance between pest and beneficial insect has seldom been achieved.

Nor can we place major dependence on a balance-of-nature approach and expect to cope with insects in an agriculture as extensive and complex as that in the United States. Single crops, grown over entire U.S. regions, present an entirely different environ-

ment than in most areas of the world.

Growers in this country cannot afford the type of pest control that results in a low-quality product or losses of a fourth or more of total crop yields. Inadequate pest control would often wipe out profit margins built up by agricultural practices that include expensive laborsaving machinery, superior seed, fertilizers, and tillage practices that conserve soil and water.

These are some of the reasons why the history of major contributions by entomological research to agriculture, up to now, has been in large measure a history of progress in chemical pest control.

Chemicals have a proved record

When USDA was about 10 years old, a chemical insecticide was the means of saving a new U.S. crop—potatoes—from a native insect that had found a liking for this new food. If paris green had not proved effective

against the Colorado potato beetle, potatoes probably would not have become a staple in the American diet.

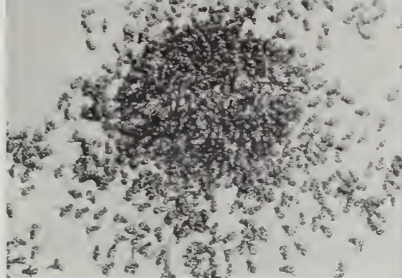
In 1916, entomologists demonstrated the effectiveness of calcium arsenate against the boll weevil, a pest that was threatening to make U.S. cotton production impossible.

As research continued, entomologists found new uses for these two insecticides and for other inorganic chemicals. Nature-produced insecticides—pyrethrum flowers, derris and cube roots, and nicotine from tobacco—were tested and recommended for many pest control needs. USDA chemists characterized the makeup of these natural organic insecticides and ultimately synthesized allethrin, a pyrethrum-like insecticide.

Then came DDT. Shown to be insecticidal in 1939 by Swiss scientists, this organic chemical was developed by USDA entomologists during World War II into a potent weapon to protect Allied troops from



Light traps measure insect infestations.



Chemical attractant, mixed with poison, lures male oriental fruit flies to death.



Mosquitoes avoid scientist's forearm treated with repellent, attack his wrist.

pest-borne diseases. It was also readied for agricultural use following the war.

Research by the chemical industries supported the postwar development of this and other effective new products. DDT was quickly joined by other chlorinated hydrocarbon insecticides such as methoxychlor, toxaphene, BHC, aldrin, dieldrin, chlor-dane, and heptachlor.

Phosphorus compounds leave less residue

The arsenal of synthetic organic insecticides became still more varied and useful with the discovery of effective phosphorus compounds. These included products such as malathion, parathion, TEPP, and methyl-parathion. Some of these phosphorus insecticides have gained preference over chlorinated hydrocarbons for many uses because they are less likely to leave chemical residues in milk, meat, and other animal products.

But as important as these chemicals have been, and continue to be, many of them have the inherent disadvantages of leaving residues on food and of often being harmful to forms of life other than insect pests.

ARS entomologists and chemists during recent years have been reexploring traditional methods of pest control in the light of new knowledge. They are utilizing new techniques and equipment to achieve effective insect pest control with minimum effects on other organisms.

And it's paying off. A recent re-

search breakthrough, that may end the career of the screwworm fly as a major U.S. livestock pest, gives new meaning to biological control.

Entomologists discovered that male screwworm flies could be made sexually sterile when radiated with gamma rays. When large numbers of sterile males are released, they mate with native females, which in turn lay infertile eggs. The systematic and repeated release of sterile males has eradicated screwworms from the Southeastern United States, and now this technique is being used in a campaign against the pest in the Southwest.

Sterilization, attractants open new era

ARS entomologists believe that gamma-ray sterilization may be useful in the control of other insect pests. Research in this area is moving ahead. At the same time they have discovered chemicals that sterilize insects. In effect, scientists are attempting to develop effective and safe ways to carry out biological control using insect pests themselves as agents of their own destruction.

Chemosterilization suggests at least two new approaches to insect control. Scientists might rear an insect pest species, sterilize it, and release it in large numbers to mate with the same species in nature. Or the chemosterilant might be combined with a specific insect attractant and used directly against the insect pest without endangering other organisms.

Insect attractants abound in nature. Insects respond to attractants in their food supply and in plants or animals that serve as hosts for reproduction. Male insects respond to attractants produced by the females.

Already, a sex attractant of the gypsy moth has been identified, and ARS chemists have synthesized a chemical, closely related to the attractant, that has proved highly successful as a survey tool against the pest. It may also prove useful for control of the gypsy moth.

In a related field, specific food attractants, in combination with a small amount of insecticide, have been a major factor in controlling various fruit flies. Entomologists and chemists have also demonstrated the presence of a sex attractant in the pink bollworm moth, a major pest of cotton, and are now working to identify and synthesize it. Similar investiga-

Turn Page



Milky disease of Japanese beetle is being used to control the grub. Infected grub is at right.



Borer-resistant corn has been bred. Moths of corn borer are trapped and collected to check borer resistance.

ENTOMOLOGISTS

(Continued)

tions are underway on the tobacco hornworm moth and other important agricultural pests.

Isolation, identification, and synthesis of specific host-plant substances that are attractive to specific insects is still another phase of current ARS entomological research. These substances, called arrestants, are responsible for the great selectivity some insects show in their attacks on specific plants. Some insects not only limit their feeding to one plant, but to one part of the plant.

Within the past year, ARS entomologists have succeeded in extracting

the arresting substance that makes the squares and bolls of the cotton plant appetizing to boll weevils. (AGRICULTURAL RESEARCH, Sept. 1962, p. 7.) And within the past few months, they have also extracted an attractant that guides boll weevils to cotton plants. These developments have exciting possibilities. For example, if scientists can identify and synthesize these substances, it might be possible to use the attractant to lure weevils to a poisoned bait made appetizing by the arrestant.

Natural insect enemies employed

Insect pathogens are being carefully investigated by State, Federal, and industrial insect pathologists. The success with milky disease, a bacterial disease of Japanese beetle grubs, gave impetus to basic studies of other infectious agents of insects—bacteria, fungi, viruses, protozoa, and nematodes. Excellent progress is being made with the organism *Bacillus thuringiensis* and certain virus diseases of important agricultural and forest insect pests.

The breeding of insect-resistant plants is continuing. This nearly ideal approach to crop insect pest control, however, has severe limitations. First, breeding material with the desired resistant characteristics is not always available; and second, when breeding material is available the de-

velopment of resistant crops is a lengthy process, sometimes requiring as long as 25 years. In other words, breeding research undertaken now is likely to benefit most the next generation of farmers.

Even so, breeding research efforts have been rewarded with seven varieties of wheat resistant to the hessian fly, a number of corn hybrids resistant to the European corn borer, and alfalfa varieties resistant to the spotted alfalfa aphid.

All insect controls are explored

In summary then, the past century of USDA's contributions to research in entomology has been one in which every insect control method is being diligently explored, but in which chemical insecticides to date have provided the major defense against the insects that threaten our health and economy.

Comparable or even bigger payoffs from broad and expanded research on several new approaches to insect control are foreseen. It is evident that safer and better control of insect pests can be attained through the full development of specific chemical insecticides; chemical and natural attractants; insect parasites, predators, and diseases; insect-resistant crop varieties; and the sterile-male method of using insects for their own destruction.☆

Susceptible corn variety suffered severe rootworm damage; resistant variety had little damage.

Burning stalks to control corn borers is in striking contrast to today's methods.





*Foreign currencies, earned
through the sale of surplus
American commodities, pay for—*

GLOBAL RESEARCH

PUBLIC LAW 480 (Agricultural Trade Development and Assistance Act of 1954) was enacted to promote economic stability of American agriculture through the sale of surplus agricultural commodities for foreign currencies. These currencies cannot be converted into dollars for research in the United States.

- *Under two sections of the law, ARS directs a research-grant program with friendly nations.*

- *One section authorizes a research program to develop new uses for farm products and to extend the present uses of products.*

- *Another section authorizes support of overseas scientific research in many fields related to agriculture—farm, forestry, marketing, economics, and human nutrition.*

■ No one expects overnight results from research. Scientific findings accumulate; and as time passes, the total effect is both significant and large. These scattered results of more than 300 grants to foreign research institutions under Public Law 480 reflect the beginning:

THYROID—From studies on forage plants, scientists in Finland found many plants of the mustard family to contain a thiocyanate ion that blocks uptake of iodine by the thyroid in animals feeding on the plants. They then performed experiments with 22

healthy adults drinking 15 different milk samples. These experiments definitely proved that cows on a mustard-family diet do not pass along enough iodine-blocking ions in milk to cause goiter in man.

VITAMIN—Finnish scientists have produced a form of synthetic vitamin C from cabbage. The product—ascorbigen—was produced after research led to the isolation of the thioglucoside *glucobrassicin* from the plant. This constituent was reacted with hydroxymethylindole and resulted in ascorbigen. The synthetic vitamin C prevented the development of scurvy in guinea pigs that were on a diet otherwise lacking in vitamin C.

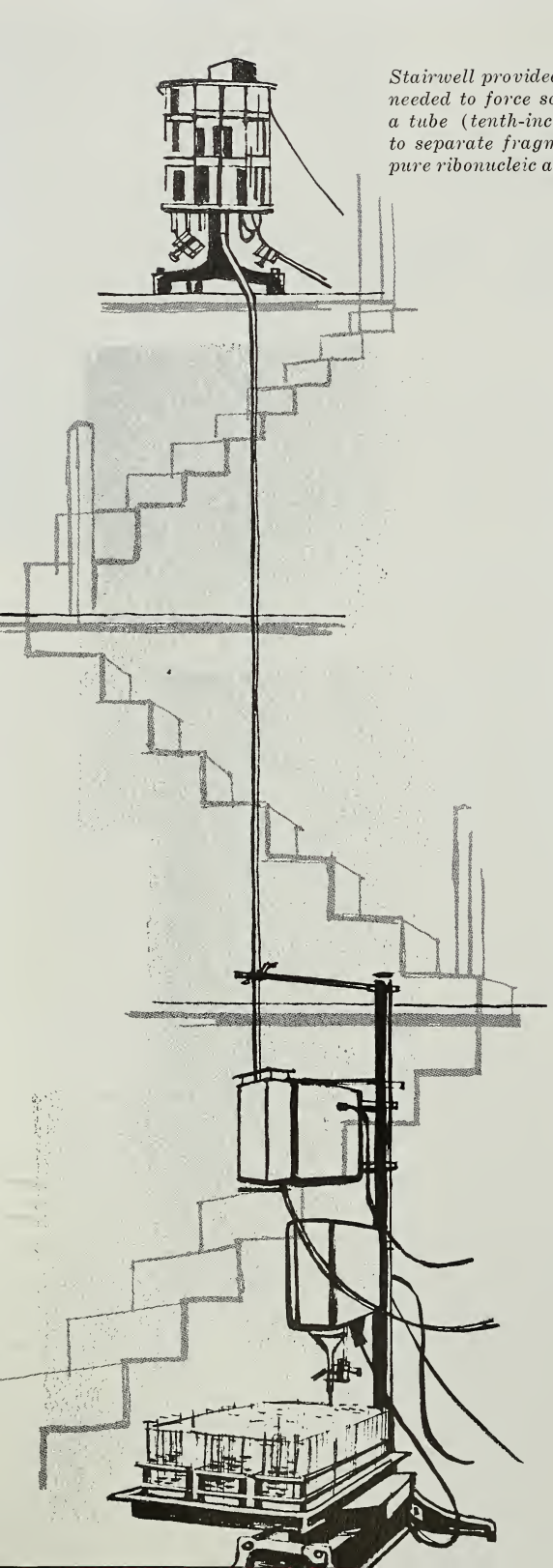
CHEESE—With the aim of improving the quality of cheese, Finnish research workers have studied the nutritional requirements of 124 strains of lactic acid bacteria, which are important in cheese manufacture. Many growth factors are still unknown, but the researchers have determined that many lactic acid bacteria strains, particularly the strain *streptococcus thermophilus*, requires calcium for growth. Calcium, on the other hand, counteracted the growth-restricting effects of citrate, which is also used in making cheese.

FUNGICIDE—Other scientists in Finland have isolated the antifungal substance in red clover roots and have named it *trifolirhizin*. This isolation casts some light on the ability of red clover to protect itself from

disease fungi and could ultimately lead to the development of commercial synthetic fungicides from red clover and other plants.

LUPINES—Because the unpalatable bitter varieties of blue lupines are more productive than the sweet varieties, Polish scientists have performed research aimed at developing lupines with all the good characteristics of the bitter blue but minus the bad taste. This research has shown that the degree of bitterness is a measure of the quantity of alkaloids in the plants and that the amount of alkaloids is inversely related to the amount of free arginine, an amino acid in blue lupine seeds. Seeds of nonbitter varieties contain three times as much arginine as those of bitter varieties.

LEATHER—Studies in England are providing facts about the main causes of leather deterioration—perspiration, heat, and moisture. Researchers there have concluded that a higher content of chrome is necessary in the tanning of leather to prevent damage from perspiration. Deterioration begins when chrome content drops below 1 percent. Studies of heat and moisture effects have shown that it is the combined action, rather than heat or moisture alone, that is harmful to leather. And, here again, chrome-tanned leather proved the most resistant to the attack. Vegetable-tanned leathers cracked and darkened during the experiments.☆



Stairwell provided height needed to force solution down a tube (tenth-inch diameter) to separate fragments of pure ribonucleic acid.

Scientists identify structure of three ribonucleic acids as they move forward in

LEARNING HOW CELLS MAKE PROTEIN

■ A significant step toward understanding the mystery of how living plant and animal cells manufacture proteins has been taken by USDA scientists.

Three soluble ribonucleic acids (RNA's), involved in protein synthesis, have been purified and structurally identified—for the first time—by ARS and Cornell University chemists at the U.S. Plant, Soil, and Nutrition Laboratory, Ithaca, N.Y. This discovery followed an earlier finding that RNA's have major structural differences.

Scientists say the next step may be learning how and why RNA's function as they do.

R. W. Holley of ARS headed the team of scientists who purified and structurally identified the three soluble RNA's. He was assisted by B. J. Apgar, S. H. Merrill, and G. A. Everett, ARS chemists; and Paul Zubkoff and B. P. Doctor, chemists of the cooperating Cornell University biochemistry department.

Ultimately, they may find ways of modifying or arresting development of living organisms. The role of nucleic acids in altering genetic characteristics of experimental animals was shown earlier. Nucleic acids also seem to have a role in cancer, birth defects, and virus diseases (AGR. RES., March 1962, p. 3).

RNA's are large chainlike organic molecules that carry out genetic instructions on how to build proteins from amino acids. The soluble RNA's determine the kind of amino acids that are combined to form a specific pro-



Mixed RNA's, obtained by ultracentrifuging beef liver, are separated out, above, in countercurrent distributor. Separated RNA's then are carefully recovered from solvents through a series of extractions, above right.

tein. The kind of protein in turn determines the nature of the organism of which it is a constituent.

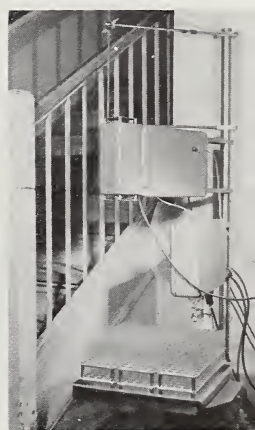
The 20 or more soluble RNA's transfer the amino acids to the protein-forming site within the cell. Each RNA is associated with an enzyme that activates a specific amino acid, triggering a series of reactions to form protein. The three soluble RNA's, purified and identified, are associated with enzymes that activate the amino acids alanine, valine, and tyrosine.

Isolation of pure ribonucleic acid has been difficult because cells contain minute quantities of the substance. For example, 140 pounds of beef liver must be processed to obtain 1 ounce of RNA, which in turn is a mixture of about 20 RNA types.

The researchers separated the RNA's—on the basis of differences in solubility—in a countercurrent distribution machine and then recovered the separated RNA's from solvents used. Approximately one-hundredth of an ounce of a specific pure RNA was obtained from the original 1 ounce of mixed RNA's.

The chemical structure of a pure ribonucleic acid is too complex to be determined by direct chemical analysis. Instead, the scientists break down the purified RNA into its component parts or fragments, known as nucleotides and oligonucleotides. By identifying these fragments, they can determine specific RNA structure.

The scientists say they now should be able to purify and structurally identify other soluble RNA's.☆



Above are units used at top and bottom of stairwell to separate fragments of pure RNA.

Fragments of RNA's are identified by measuring distance material moves in an electric field.



*Just add cold water
and you have—*

INSTANT ORANGE JUICE FROM POWDER

■ A new process for making instant orange powder, now under development by ARS and Florida Citrus Commission scientists, may add this product to the growing list of convenience foods available to housewives.

The experimental powder dissolves readily in cold water to make a good-tasting, nutritious orange juice. Orange powder offers substantial shipping and storage advantages because it is lightweight and needs no refrigeration. These advantages make the product particularly attractive for export.

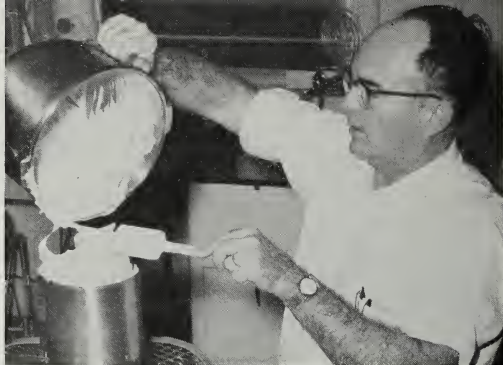
Cooperating in the research are M. K. Veldhuis, O. W. Bissett, and J. H. Tatum of ARS, and L. G. McDowell and C. J. Wagner, Jr., of the Florida Citrus Commission. Working at the ARS Fruit and Vegetable Laboratory at Winter Haven, Fla., they make the orange powder with a foam-mat drying process developed by the ARS Western utilization research laboratory, Albany, Calif.

To make the powder, small amounts of soya protein and methyl cellulose are added to concentrated orange juice to whip it into a stable foam. The foam is then forced through a press in spaghetti-like strips onto a moving belt and dried in a stream of heated air.

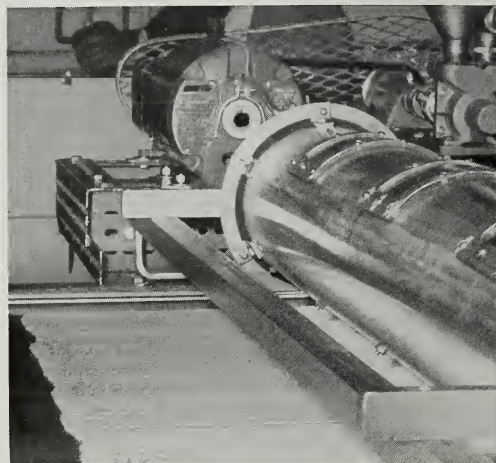
The dried strips are ground into powder and flavored with a solid substance containing "locked-in" orange oil. The powdered juice is packaged with a drying agent, which absorbs excess moisture and prevents caking.

Much research is needed, however, before the new powdermaking process is ready for commercial use. For example, the scientists must determine whether it can be stored for long periods without flavor changes or other serious deterioration. Further research is also needed to determine the drying conditions that will best preserve the fresh orange juice flavor.

The scientists are pressing ahead to resolve these questions. They believe a commercial orange juice powder produced by the foam-mat process will be part of the answer to the increasing pressure for new outlets for the growing citrus industry.☆



Foamed citrus concentrate is ladled into drying equipment in making orange powder.



Then, the foamed orange concentrate empties onto a moving belt of the foam-mat dryer.

The orange product leaves dryer as pretzel-like sticks, ready for grinding into powder.



RAM FERTILITY INDEX



■ An improved semen index for predicting ram fertility appears more accurate than any fertility test yet devised for sheep. If field tests confirm experimental findings, ARS scientists say the index will help sheep producers in several ways.

With fertility data on each prospective sire, for instance, the producer will be able to select the most efficient breeders, balance genetic merit and fertility more objectively in choosing sires, and decide whether a particular sire of high genetic merit—but less than optimum fertility—can be used profitably.

The index is based on four semen traits studied at the U.S. Sheep Experiment Station, Dubois, Idaho. It proved 55 percent more accurate in predicting the fertility of 136 rams than a semen score used earlier.

Using the index, scientists predicted

that each of 113 rams would settle at least 80 percent of the ewes with which they were mated. Only six of these rams were poorer than predicted; the least fertile one settled 60 percent of the ewes it was mated with.

The index was computed by ARS animal geneticists C. V. Hulet and S. K. Ercanbrack at the Dubois station, operated by USDA in cooperation with the University of Idaho.

The scientists developed the index by taking semen samples of 39 rams. Each sample was tested for 13 characteristics. Each tested ram was then mated to five fertile ewes, all in heat at about the same time. The sire's fertility was gaged by the number of ewes that conceived.

Hulet and Ercanbrack found that only four semen traits make worthwhile independent contributions to fertility prediction. These four—pH

of the semen, percentage of live normal sperm, percentage of abnormal sperm, and percentage of abnormal necks of sperm—are the basis of the index.

Measurements of these traits are applied in a simple formula. Solution of the formula gives the expected fertility—the fertility index—of the semen-tested ram.

The formula: $174 \text{ minus } 17.19 (\text{pH}) \text{ plus } 0.28 (\text{percent live normal sperm}) \text{ minus } 0.28 (\text{percent abnormal sperm}) \text{ minus } 0.20 (\text{percent abnormal necks of sperm})$. Sperm motility may be substituted for percentage of live normal sperm in the formula with equally good results.

Data from a larger number of rams will be studied in further tests.☆

THE WRONG COW CAN COST MONEY

Brood cow at left weaned much heavier calves. She netted \$1,050 in 12 years; the one at right, \$565.



■ A beef cow may wean a calf each year but still return much less profit than a cow that raises the same number, but heavier, calves. This is emphasized in a USDA-Oklahoma comparison that cites case histories of two brood cows.

The two cows calved first in 1950 and have received like feeding and management. In most years, they were bred to the same bulls. Both have proved regular producers; one has weaned 12 calves, the other 13.

But a big inherent difference has made one cow much more profitable. This difference is revealed by records

for the 12-year period 1950–61 (figures are not yet available for the two calves produced in 1962).


Cow *A* weaned 11 calves in the 12 years. Her calves averaged 383 pounds each at about 7 months, the age most feeders are sold. At a sale price of 25 cents a pound, these calves would have grossed \$1,050. Cost of maintaining the cow was \$485. So she netted \$565, or about \$47 per year.

Cow *B* weaned 12 calves in the 12 years. But her calves averaged 512 pounds at 7 months. Figuring the same calf price and maintenance costs, cow *B* has netted \$1,050, or \$88 per

year. Take away one of her calves to match cow *A*'s production, and cow *B* still would have returned \$77 a year—nearly 65 percent more annual profit than cow *A* returned.

This comparison was made by ARS and Oklahoma researchers at USDA's Fort Reno Livestock Research Station, El Reno, Okla. The Oklahoma Agricultural Experiment Station cooperates in research there.

There is a simple way, say the scientists, to avoid having a herd full of calf producers like cow *A*. Choose replacement heifers that were heaviest at weaning.☆



A Tough Job:

REVEGETATING MOUNTAIN SLOPES

Native Hay Is Used as Seed Carrier and Mulch on Washington Slopes

■ Native grasses have been established on a barren mountain slope in eastern Washington, where growing conditions are too harsh for cultivated species commonly used in range seeding. Successful revegetation of such slopes is needed in many areas to control erosion.

In recent experiments on a plot in the Seven Devils Mountains near Riggins, Idaho, ARS range conservationist D. H. Gates established seedlings of native species by using native hay as a seed carrier and mulch. Hay was harvested carefully from an area adjacent to the experimental plots. The mulch was held in place by staked chicken wire.

Seedlings grew from seeds in the hay, and the mulch provided protection during the critical early-growth stages. In addition to the native grass, other plants native to the area—sedge, lupine, and buckwheat—have also become established in the test plots.

Grazing and trampling strip steep slopes of vegetation

The test area is characteristic of many high-altitude slopes in the Northwest where grazing and trampling by livestock have stripped off the vegetative cover. Gates' tests, conducted in cooperation with the Washington Agricultural Experiment Station, were 7,000 feet above sea level on slopes of 10 to 65 percent.

Even with native hay, seedling survival rate was low, Gates found. Three out of 25 seedlings per square foot survived the 1960 growing season under the mulch held in place by chicken wire. Two out of 10 per square foot survived in a plot where the native hay mulch was held in place by pine boughs. One out of two per square foot survived in a plot covered with native hay with nothing to hold it in place.

Plots were planted in September 1959, and a count of emergent seedlings was made in July 1960, followed by a

survival count in September 1960. Most of the plants that survived the critical first year are still standing.

Revegetating these slopes will not be easy, Gates points out. Seedling mortality is very high because of extremely harsh growing conditions at the high elevations. Earlier attempts with cultivated species—orchardgrass, slender wheatgrass, mountain brome, smooth brome, timothy, and Idaho fescue—indicated that species which do well in some mountain environments will not survive under extreme conditions.

Type of mulch used plays a major role

The native hay mulch was tried after attempts between 1957 and 1959 to establish the cultivated grasses failed. These tests proved, however, that the type of mulch used has a bearing on how many seedlings will emerge. Four mulches had been tested: a half inch of sawdust, an inch of sawdust, a 50-percent pine bough cover, and a 100-percent pine bough cover. The 100-percent pine bough cover was best for seedling emergence, and the half-pine bough mulch second best.

Gates also learned that field application of fertilizer does little to increase emergence of introduced grasses and has no effect on seedling survival. Nitrogen was applied alone at 40 pounds per acre, alone at 20 pounds per acre, with phosphorus at the rate of 40 pounds each, and with phosphorus at the rate of 20 pounds each. What little advantage resulted lay with the nitrogen and phosphorus combinations.☆

Best Grasses Are Named for Range Slopes in Five-State Area of West

■ New hope for revegetating depleted mountain rangelands in the West is the result of a comprehensive 3-year ARS research project in cooperation with the Forest Service and State agricultural experiment stations.

ARS range conservationists believe they have found answers to some of the problems.

In experimental plantings at six locations in the intermountain region, the scientists have found—

1. Grass species widely adapted to problem slopes.
2. Seedbed preparation and time of seeding for these species is important.
3. Rodent control is necessary.

The test sites included the Gravely Range in southwestern Montana; locations near La Grande in eastern Oregon and Preston in southeastern Idaho; two sites, Galena Creek and Dog Valley, in west-central Nevada; Ephraim Canyon in central Utah; and the Nez Perce National Forest in northern Idaho.

It proved impossible in one season to establish grass stands in the Nez Perce, and this location was abandoned because of its inaccessibility. Thus, results are based on findings at the other sites. Although grass stands were established at Galena Creek, they were not good enough for either erosion control or forage.

Smooth brome (*Bromus inermis*) and meadow foxtail (*Alopecurus pratensis*) proved best adapted to high elevations or northern latitudes. Good stands were established at Ephraim Canyon (elevation 10,000 to 10,500 feet) and in the Gravely Range (elevation 9,000 feet).

Intermediate wheat grass (*Agropyron intermedium*) was found most suitable at the lower sites—La Grande, Preston, and Dog Valley.

Eighteen grasses were tested, in all, and their performance was rated good, fair, or poor.

Control of competing vegetation is vital

The most important need in seedbed preparation is to eliminate or control competing vegetation, the scientists reported. Application of herbicides such as 2,4-D in the spring was particularly helpful at Ephraim Canyon, Preston, La Grande, and Dog Valley. Any tillage practice suitable for a particular site can be used to meet this competition, they said.

Mulches were found extremely useful for improving stands in the face of handicaps such as soil crusting, soil compaction, and frost heaving. The only exception seemed to be at Preston where three types of mulch failed to improve grass stands. Wheatstraw, woodchips, sawdust, and sand were tested successfully as mulches or seed covering at the other sites.

Seeding in the fall generally gave best results. This was true at La Grande, Dog Valley, and Ephraim Canyon. Late fall and early spring seedings were satisfactory at Preston. Fall and July seedings proved equally satisfactory in the Gravely Range.

Rodents, especially gophers, were a serious problem at all sites. Controlling them with traps or poison is essential to establishing seedling stands.☆

ZINC DEFICIENCY OF POTATOES

■ Zinc deficiencies that caused “fern leaf” growth disorders in Russet Burbank potatoes in a Washington experiment invariably were associated with applications of phosphorus fertilizers.

The association was made by ARS soil scientists L. C. Boawn and G. E. Leggett, in cooperation with the Washington Agricultural Experiment Station.

Severe zinc deficiency in Russet Burbank potatoes causes young leaves to cup upward and roll so much that terminal growth resembles the unfolding fronds of certain ferns. The term “fern leaf” describes the condition. Stunting is another symptom.

Soil was not previously cropped

In the tests, potatoes were planted in soil not previously cropped. The soil was known to be low in zinc. This was caused by removal of at least 1 foot of surface soil when land was leveled in preparation for irrigation. Previous observations had shown that fern leaf disorders are associated almost entirely with areas in a field where considerable surface soil has been removed. The scientists applied nitrogen, potassium, and sulfur on all plots to eliminate shortages of these elements.

Potato plants showed symptoms of zinc deficiency by the end of the bloom period when grown on plots fertilized with 43-percent superphosphate at the rate of 100 pounds per acre. Plants matured naturally in plots where zinc and phosphorus were applied, in plots where only zinc was applied, and where neither zinc nor phosphorus was applied.

How does zinc interfere with phosphorus?

Zinc was applied in the form of zinc sulfate at a rate of 10 pounds per acre.

Scientists have not determined whether phosphorus interferes with zinc availability by preventing entry of zinc into the plants, or by blocking movement of zinc from roots to leaves.

In the Northwest, zinc deficiency commonly occurs in zinc-sensitive crops—such as corn and beans—grown on land that has been leveled for irrigation. Deficiency symptoms in plants are most prominent the first year new irrigation land is used. Weathering of soil exposed by land leveling seems to promote zinc availability.☆

COTTON WITHSTANDS RECHARGE IRRIGATION

Tests in low-rainfall area delayed maturity, did not lower yield materially



■ Cotton may be grown successfully in areas where prolonged irrigation is used for recharging the ground water supply, USDA-California studies show.

In limited experiments at Fresno, ARS geologist E. E. Haskell, Jr., and soil scientist W. C. Bianchi found that cotton tolerated irrigations lasting 4 to 15 days when the water was not allowed to pond. Their work was in cooperation with the California Agricultural Experiment Station and the California Department of Water Resources.

Previous research has shown that prolonged irrigation is an effective method of recharging ground water supplies in areas of low rainfall.

This method might be less expensive than present methods—if it can be used without major damage to the crop, the scientists say.

Surface water from rivers is used for replenishing ground-water supplies lowered by irrigation wells. Usually the water is spread on the ground surface, in basins formed by dikes, or is injected into the underground water-bearing formations.

Haskell and Bianchi studied the effects of prolonged irrigation on test plots in a farmer's field of Acala 4-42 cotton. They applied water three times during the growing season, each time starting when the farmer irrigated the adjacent field. Three variations in length of prolonged irriga-

tions were tried in the recharge tests:

- Each irrigation lasting 4 days.
- Each irrigation lasting 8 days.
- First two irrigations lasting 15 days; third irrigation, 8 days.

Water ran continuously during the tests but was not allowed to pond.

Cotton yields were not significantly lowered in any of the experiments, although early-season plant growth and maturity were noticeably delayed in all plots. The researchers report that plants in the 4-day and 8-day plots were shorter and more compact at season's end than plants in the adjacent control field. Yellowing of leaves was noted after all irrigations on the plot receiving two 15-day irrigations and one 8-day. ☆

STORM-RESISTANT COTTON

New strains resist damage by wind, rain; pick well mechanically

■ Several storm-resistant strains of cotton that can be harvested with a spindle-type picking machine are being developed for southern Texas by USDA and the Texas Agricultural Experiment Station.

In tests, the new strains have retained their lint in burs in relatively undamaged condition until harvest. Wind and rain damage to lint is a serious problem in commercial varieties of cotton that are now grown in southern Texas.

Storm resistance in cotton comes from structural characteristics that produce a "tight" boll—that is, a boll in which cotton is held firmly. The bur may be cup shaped instead of wide open when it is ripe, or it may pinch the cotton in a pitlike depres-

sion. Wrinkles on the bur wall or a sticky substance on the wall also may hold the lint fibers tightly. A resistant strain may have one or more of these characteristics.

From a practical viewpoint, preharvest loss is the measure of storm resistance. The test strains have been outstanding in this respect; in 3 years, average preharvest losses ranged from 3.3 to 6.9 percent of total yield. Average loss in an open-bolled check variety, Deltapine Smooth Leaf, was 16.3 percent.

However, the commercial variety had a slightly better net yield than test strains because it had such high yield potential and was so "pickable" that it was able to sustain heavy storm losses and still compare favorably

with test strains in yield. Increasing yield potential of storm-resistant strains is one of the goals of present breeding.

Before the new strains were developed, it was generally believed that lint in "tight" bolls could not be picked easily with a spindle-type harvester. However, the amount of lint that was left on the test plants was less than the researchers expected, and more cotton probably would have been picked from each plant if the machine had been adjusted specifically for harvesting "tight" boll strains.

Breeding and testing work on the new strains is being conducted by G. A. Niles of the Texas station and ARS agronomist T. R. Richmond. ☆

Insects will fight citrus pest

Several species of beneficial parasites of the brown soft scale, a serious pest of citrus in Texas, have been imported to the United States from Israel by ARS entomologists.

The parasites, which help control brown soft scale in Israel, are currently being propagated and tested at the ARS parasite introduction laboratories in Moorestown, N.J., before being released in Texas groves.

First brucellosis-free swine area

The first Validated Brucellosis-Free Area—Dooley County, Ga.—and the first Validated herd in a Validated Free Area—Burton-Coody registered swine, Vienna, Ga.—have been established in the Nation's swine brucellosis eradication program.

These milestones marked the completion of a cooperative Federal-State pilot project launched in October 1961 to establish guidelines for an area eradication program.

C. K. Mingle, who heads the brucellosis eradication work for ARS, said that blood testing of 2,388 breeding swine in 376 Dooley County herds revealed only 5 infected herds and 17 animals with brucellosis.

"The level of infection in the county—only 0.7 percent of the breeding animals and 1.3 percent of the herds—was surprisingly low," Mingle said. "Before the pilot project was launched, blood samples taken at slaughter plants in southern Georgia indicated an infection rate of 10 to 20 percent."

Dooley County has been granted a Validated Brucellosis Free status for a 3-year period, provided the accumulated level of infection does not ex-

ceed 5 percent of the county's herds.

Dooley County plans to keep this from happening. Movement of swine into the county will be restricted. Owners of Validated Brucellosis Free herds will maintain this status by blood testing all breeding swine annually. Other herd owners will blood test at least 10 percent of their breeding swine during the 3-year period. Should any herds become infected with brucellosis during this time, they will be placed under quarantine until free of the disease.

The Dooley County project reaffirmed the adequacy of testing procedures for detecting and handling Brucella-infected swine herds.

The project has demonstrated the feasibility of testing large numbers of swine by the anterior vena cava method—the taking of a blood sample from the large vein located within the base of the neck.

Targhee rams sire heavier lambs

Targhee rams used on commercial ewes are producing lambs in Hawaii that are heavier at weaning time than those sired by commercially available rams on the Islands.

The Targhee breed was developed through ARS research at the U.S. Sheep Experiment Station, Dubois, Idaho, and has contributed much to the improvement of commercial sheep in the West.

Iraqi translates USDA bulletins

The Iraqi Government has translated 35 USDA bulletins, leaflets, and articles into Arabic for use by agricultural leaders in that country.

They are published in a volume of the Iraqi Journal of the Ministry of

Agrarian Reform. Several of the articles were translated into Kurdish and broadcast over Radio Baghdad.

Subjects include crop and livestock insect and disease control, weed control, home gardening, and ornamental and vegetable production.

H₂O₂ speeds pine seed germination

Killing germs is not the only thing hydrogen peroxide (H₂O₂) is good for. It can speed up pine seed germination—and quicker than anything now generally used to reduce germination time.

Experiments performed by USDA's Forest Service, the Georgia Forestry Commission, and the Georgia Forest Research Council have proved that a 48- to 96-hour soak in 1 percent H₂O₂ increased the speed of germination of loblolly pine seed equal to that obtained by stratification (pregermination treatment by storage in moist condition 1 to 3 months before planting). And soaking in H₂O₂ had no effect upon total germination.

Soaking slash pine seed in 1 percent hydrogen peroxide for 24 to 48



hours increased the rate and the extent of germination beyond that of the stratified seed.

This shortening of the germination period is important because a large part of mortality occurs during germination.

Forest Service scientists are encouraged with attempts that are now underway to develop an economical procedure for the H₂O₂ treatment in pine tree nurseries.

AGRISEARCH NOTES

Flowerpot dip eliminates algae

Grubby-looking flowerpots may be a thing of the past, thanks to two USDA scientists. They found that a commercial preparation sold for general use as a disinfectant provides excellent control of unsightly and persistent algae growing on clay greenhouse pots.

The disinfectant is a 10-percent solution of a quaternary ammonium compound (para di-isobutyl phenoxy ethoxy ethyl dimethyl benzyl ammonium chloride). A 1-percent solution of this active ingredient, when used as a dip, kept flowerpots free of algae for 24 weeks in tests conducted by N. W. Stuart and H. M. Cathey, ARS horticulturists.

Nurserymen and florists have a continuing problem with algae growth, which gives clay flowerpots an un-

attractive appearance and may cut sales appeal.

The algae are controlled by selective chemical action similar to that of chemical plant growth regulators used on ornamentals.

The scientists found that African violets and Easter lilies grown in treated pots either developed fewer roots than plants in untreated pots or the roots were distributed throughout the upper portion of the pot soil ball.

In still another test, they learned that combining the disinfectant with phosfon in solution nullifies the effect of the phosfon on chrysanthemums. Phosfon is sometimes used to shorten chrysanthemum stems without changing bloom size.

Florists are advised to apply the dip only to the outer surface of pots in which phosphon-treated chrysanthemums are grown.



After 3 months, the clay pot dipped in 1-percent solution (right) was free of algae. A 0.25-percent dip did not control the algae growth (left).

Advice on geranium wilt control

Verticillium wilt is a threat to geraniums because the disease is difficult to diagnose, ARS scientists advise florists and home gardeners.

This fungus disease is often mistaken for bacterial rot. Some symptoms are similar. Consequently, precautions taken to eliminate bacterial rot may not always control wilt.

Florists should be especially wary if they grow geranium stock in unsterilized outdoor beds to avoid buying cuttings that may be infected with bacteria, cautions pathologist Frank P. McWhorter of ARS and the Oregon Agricultural Experiment Station.

Growing geraniums in outdoor beds is especially hazardous because verticillium is found in soil in which certain host plants have been grown. Hosts include trees, herbaceous plants, ornamentals (especially dahlias), many kinds of nursery stock, potatoes, tomatoes, cotton, mint, and berries.

Unlike bacteria-infected cuttings, those cuttings from plants infected with verticillium may appear normal when sold. Later symptoms such as dwarfing, yellow spotting and yellow leaves, stem rotting, and wilt may appear in that order.

For control, McWhorter advises florists to select stock carefully, grow plants at least two generations in sterilized soil, and have test cultures made from select stock for both bacterial rot and verticillium.